Vancouver Island Generating Project

Workshop 3

Feasibility of New Transmission Systems and Other Supply Alternatives

April 23, 2003

Key Themes

- Dependable capacity shortfall on Vancouver Island
- New resources required
- Least-cost reliable supply plan requires:
  - Long-term perspective
  - Near-term development certainty
- Few alternatives
- Significant investment and lead-time
- VIGP:
  - Preserves least-cost option
  - Furthest advanced
  - Other strategic benefits.

Outline

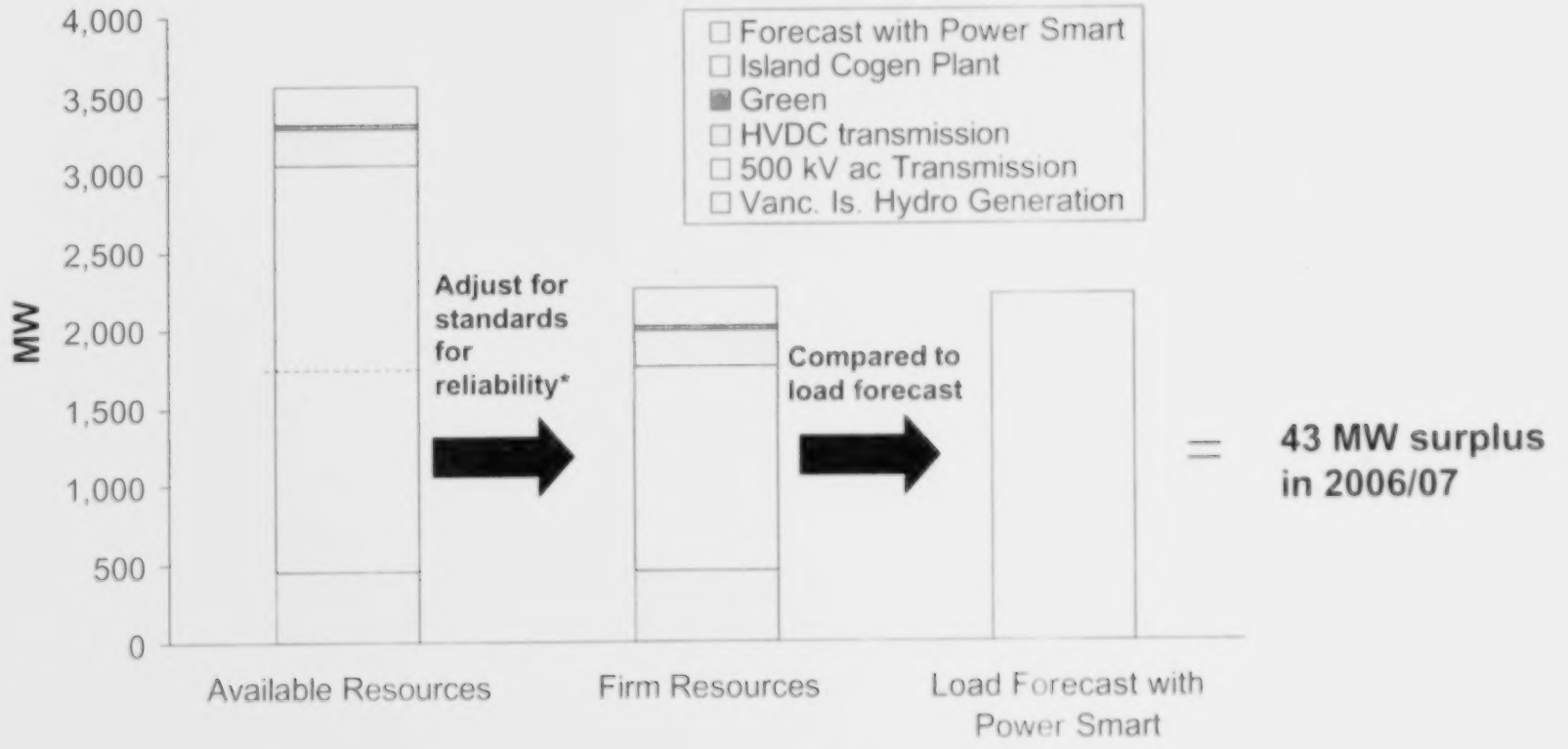
- Recap of Workshops #1 and #2
- Addressing the Vancouver Island Supply Challenge
- Identification and Assessment of Alternative Supply Strategies
- Resource Portfolios
- Modeling/Data Assumptions
- Summary of Results
- Conclusions

Recap of Workshops #1 and #2

Key Points

- BC Hydro must meet the electricity demand of its customers
- We plan to meet projected demand at minimum cost while balancing environmental and social objectives
- Industry reliability standards - single contingency criteria

Design for Industry Standards for Reliability



* One 500 kV AC circuit out of service to meet reliability guidelines.

Key Points

- Peak demand (capacity), not annual energy use is the key concern
- New Vancouver Island supply system reinforcements primarily driven by:

  (1) Aging High Voltage Direct Current (HVDC)

  - End-of-life strategy; planned retirement in 2007
  - Prudent to have replacement supply in place earlier

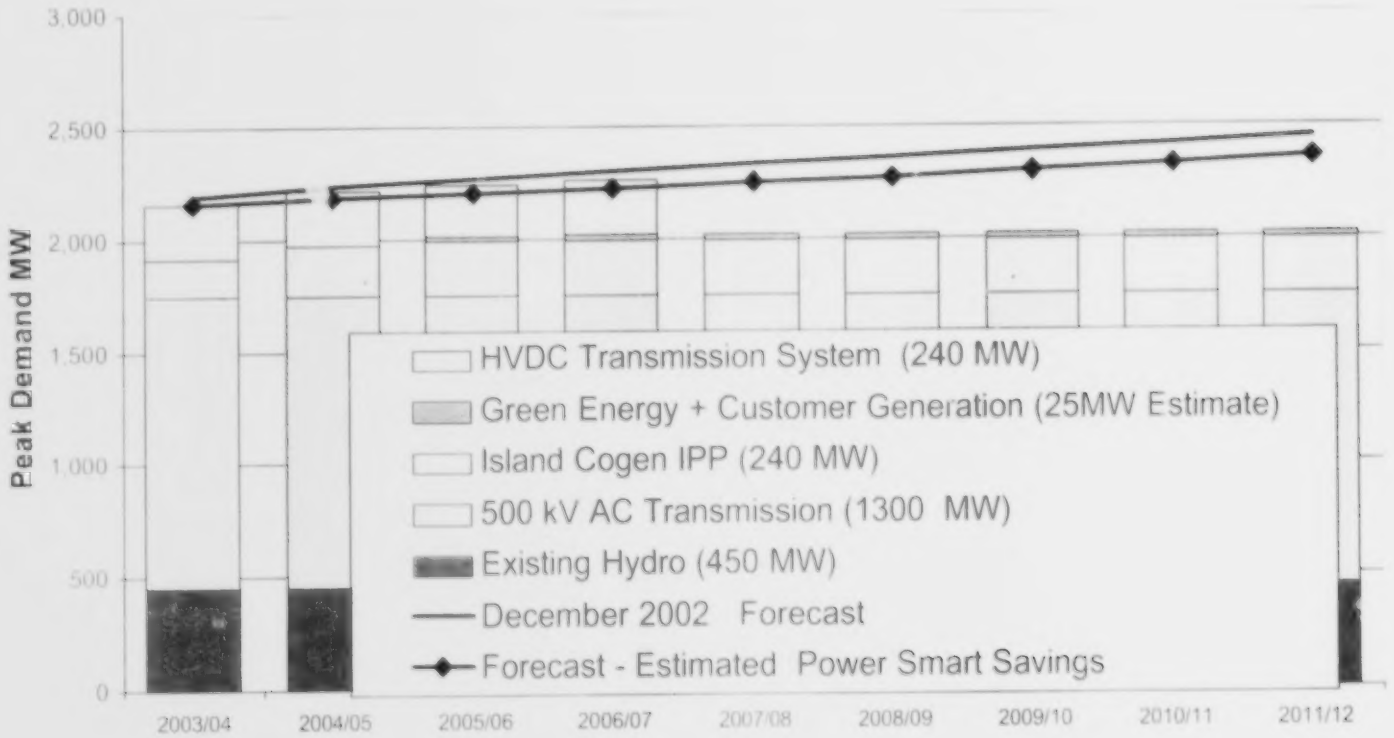
  but also by:

  (2) Forecast Increases in Demand

  - Even with Power Smart; and
  - Green and Customer Generation

- New resources required

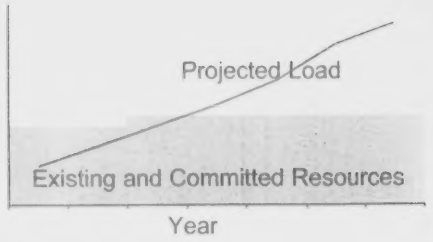
Vancouver Island Dependable Capacity



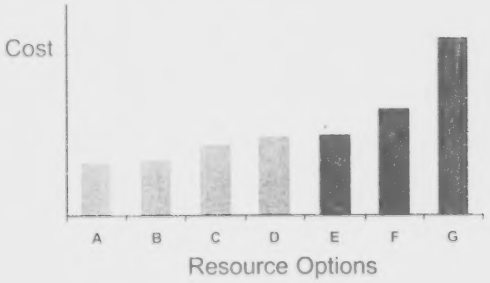
Addressing the Vancouver Island Supply Challenge

least-cost reliable electricity supply requires...

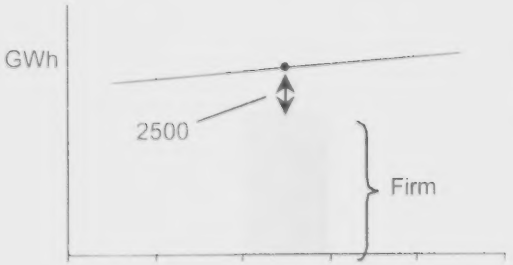
1. Determine Need for New Resources



2. Identify and Assess Supply Strategies and Resource Options

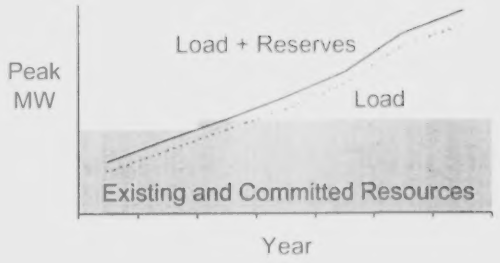


3. Meet Energy Planning Criteria

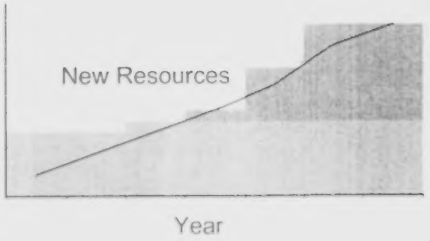


... *a long-term planning perspective*

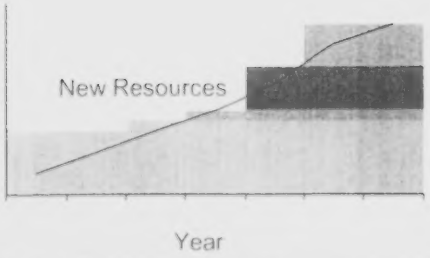
4. Meet Generation Capacity Planning Criteria



5. Model Alternative 20-Year Resource Portfolios - net present value analysis

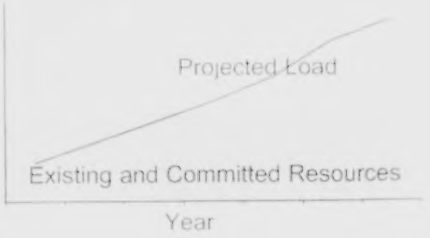


6. Sensitivity Analyses and Other Planning Considerations



least-cost reliable electricity supply requires...

1. Determine Need for New Resources



2. Identify and Assess Supply Strategies and Resource Options

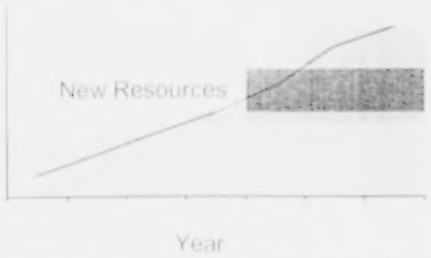
3. Meet Energy Planning Criteria

... *a long-term planning perspective*

4. Meet Generation Capacity Planning Criteria

5. Model Alternative 20-Year Resource Portfolios – net present value analysis

6. Sensitivity Analyses and Other Planning Considerations



Identification and Assessment of Alternative Supply Strategies

Alternative Supply Strategies To Replace the HVDC System

- There are three basic strategies:
  - On-Island Generation Options
  - New Transmission with Incremental Mainland Generation Options
  - Load (Demand) Reduction

Assessment of On-Island Generation Options

- Gas-based Generation (CCGT) - VIGP
  - Requires gas supply (GSX)
- Non-Gas Generation Resources
  - Other thermal; hydro; other renewable
  - 25 MW of new dependable capacity planned - competitively bid
  - Otherwise insufficient resources to meet 2007 capacity shortfall
  - Therefore not modeled
- Continuing to evaluate on-Island and system resources
  - For future load growth
  - Energy/capacity/generating flexibility
  - Resource potential
  - Cost

How Much Green Energy is Equivalent to VIGP?

- VIGP = 2,100 GWh annual energy, 265 MW dependable capacity
- For illustration: estimate of equivalent green energy projects

Output	1 VIGP		525 Wind Turbines	15 - 40 Small Hydro Plants	3.8 M tonnes Biomass Required
Energy	2,100 GWh/year	=	2,100 GWh/year	2,100 GWh/year	2,100 GWh/year
Capacity	265 MW	=	0MW	120 MW	265 MW

Assessment of New Transmission Options

- Options include:
  - New 230kV AC cables
  - HVDC replacement
  - 500kV AC options
- All transmission alternatives require incremental Mainland generation
  - Gas, coal, CBM , woodwaste, hydro and other renewables
  - Many are competitive
  - Also rely on imports

Assessment of New Transmission Options

- New Transmission with Mainland Generation is a feasible supply alternative
  - Therefore modeled
  - Cost / engineering estimates at planning stage
- Transmission option modeled is 230kV AC
  - Costs comparable HVDC
  - Fewer seismic / life-expectancy risks then HVDC
  - Estimated 5 year lead-time; 2008 earliest in-service

Assessment of Demand Reduction Options

- Demand Reduction Options
  - Power Smart - conservation and load displacement
  - Contracted Load curtailment - Schedule 1852
- On-Island demand reduction is not a feasible alternative to meet 2007 capacity shortfall
  - 100 MW of Power Smart already planned
  - Contracted load curtailment provides operational flexibility, but is not a long-term planning option
  - Therefore not modeled
- Continuing to evaluate on-Island and system resources
  - For future load growth

Resource Portfolios

Resource Portfolios

- Three portfolios developed to represent feasible supply strategies. key resources to 2010 include:

Portfolio 1 "VIGP Only"	Portfolio 2 "On Island CCGTs"	Portfolio 3 "Mainland Generation"
• VIGP in 2006 • New transmission to the Island and Mainland generation starting in 2010/11	• VIGP in 2006 • Additional on-Island 250 MW CCGT in 2010/11.	• New transmission to the Island in 2008/09 • New Mainland generation starting in 2010/11. • Centra Gas system is upgraded in order to serve ICP

- Also:
  - Power Smart, Green, Customer generation, other resources are common
  - Portfolio 3 assumes Centra upgrade; Interior-to-Lower Mainland transmission and Revelstoke Unit 5 in-service sooner

20-Year Resource Portfolios

	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Portfolio 1	GSX	265 MW VIGP				New Transmission to VI ML Generation		Rev 5	Int - LM 500 kV	Mica 5		ML Generation		Rev 6		ML CCGT	Mica 6
Portfolio 2	GSX	265 MW VIGP				VICCGT		Rev 5		Int. to LM 500kV Mica 5		VICCGT		Rev 6		ML CCGT	Mica 6
Portfolio 3	Centra Upgrades			New Transmission to VI Rev 5		ML Generation		Int - LM 500 kV	ML Generation	Mica 5		ML Generation		2nd New Transmission to VI Rev 6		ML CCGT	Mica 6
	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22

Portfolio 1 - "VIGP Only" - gas supply to ICP and VIGP via GSX followed by 230 kV AC transmission to VI and ML generation

Portfolio 2 - On-Island CCGTs - Gas supply via GSX, both VI and ML Generation

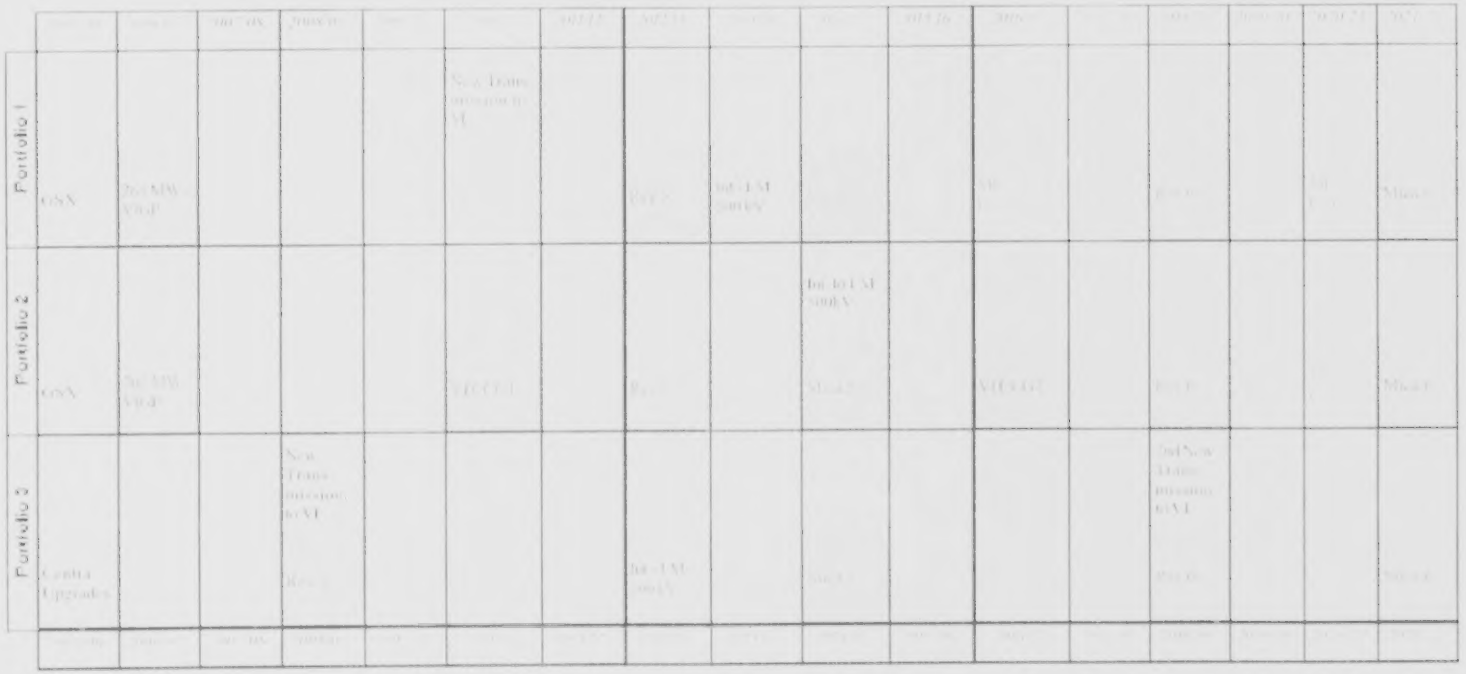
Portfolio 3 - Mainland Generation - 230 kV AC transmission to Island. ML Generation, gas to ICP via Centra Upgrades

All Portfolios: All include additions for Power Smart, Resource Smart, Customer Based Generation, and Green Energy

- Gas Supply
- VIGP - VICCGT
- Transmission
- Capacity Only
- ML Generation (with CCGTs used as proxies for future least cost resource additions)

ML - Mainland
VI - Vancouver Island

20-Year Resource Portfolios



Portfolio 1

Portfolio 2

Portfolio 3

All Portfolios

Modeling / Data Assumptions

Modeling Assumptions

- Timing of New Resources to meet projected load
- Market-based approach to resource valuation/acquisition
- Positive co-relation between gas and electricity prices
- CCGT as proxy for least-cost Mainland generation resource
- GSX and VIGP costs to date in all portfolios
- Centra Upgrade Costs in transmission portfolio

Key Data Assumptions

- December 2002 Load Forecast with "new" Power Smart
- Full capability of:
  - Existing BC Hydro system plus Resource Smart
  - Existing plus planned IPPs
- Gas price forecast (Sumas)
  - Translates to levelized price of $4.80/GJ (from 2005)
- Electricity price forecast (BC border)
  - Translates to levelized price of $56/MWh (from 2005)
- 8% Discount Rate

Key Data Assumptions

- Fuel Tax: 7%
- GSX: NPV annual revenue requirement
  - Derived from $322M capital
- Centra Upgrades: NPV incremental annual revenue requirement
  - Derived from $218 M capital
- Sunk Costs: $61M for VIGP and $46M for GSX

Major Resources

- VIGP:
  - In-Service July 2006
  - $301M including overhead ($340M with IDC)
  - $16M Annual Operating and Maintenance costs
  - Heat rate: 7308 GJ/GWh (higher heating value or HHV)
- Future CCGTs
  - Mainland Generation proxy - 250 MW CCGT at Kelly Lake
  - $285M ($294M including overhead)
  - $14M Annual Operating and Maintenance Costs
  - Heat rate: 7250 GJ/GWh (HHV)
  - In Portfolios 1 and 3, first Mainland CCGT is added in 2010.
  - In Portfolio 2, next CCGT added in 2010/11

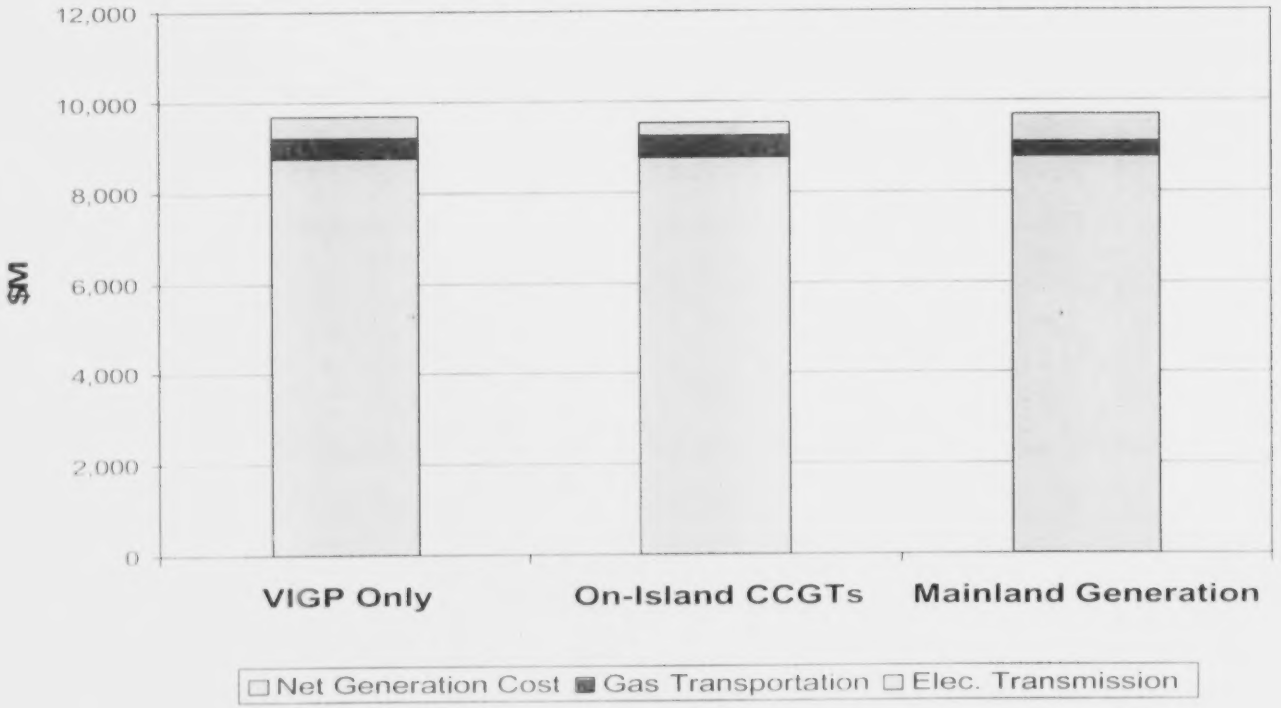
(costs are in 2002 dollars)

Major Resources

- New Vancouver Island Transmission: 230 kV Cables
  - Earliest in-service: 2008
  - $168M plus 4% overhead
  - $1.1M Annual Operating Cost
  - Deferred to 2010 with VIGP only (Portfolio 1)
  - Not needed in 20-year plan if future On-Island CCGTs (Portfolio 2)
- New Interior-to-Lower Mainland 500 kV Transmission
  - $215M plus 4% overhead
  - $4.1 M Annual Operating Cost
  - Needed in 2012/13 if no VIGP (Portfolio 3)
  - Deferred to 2013/14 if VIGP only (Portfolio 1)
  - Deferred to 2014/15 by VIGP plus future on-Island CCGTs (Portfolio 2)

Summary of Results

Comparison of Net Present Value Costs of Alternative 20-Year Portfolios ($M)



- Significant investment required across all resource portfolios

Comparison of Net Present Value Costs of Alternative 20-Year Portfolios ($M)

Cost Components	Portfolio 1 VIGP Only	Portfolio 2 On-Island CCGTs	Portfolio 3 Mainland Generation	Portfolio 2 minus Portfolio 1	Portfolio 3 minus Portfolio 1	Portfolio 2 minus Portfolio 3
Net Generation Cost	8,762	8,762	8,762	0	0	0
Vancouver Island Gas Transportation	455	480	347	25	-108	132
Transmission Cost Including Losses	460	283	577	-177	118	-295
Total NPV Cost	**9,677**	**9,525**	**9,687**	**-152**	**10**	**-162**

- On-Island CCGTs is least-cost by $150-$160M NPV
- VIGP Only and Mainland Generation costs the same
- VIGP preserves least-cost option
- Results are insensitive to high/low gas prices and discount rates

Key Findings and Other Planning Considerations

- All supply strategies require significant system investment
- On-Island gas strategy is least-cost portfolio by $150-$160M NPV
- VIGP Only and Mainland Generation costs the same
- Therefore, VIGP does not lock-in future Island CCGTs
- Results insensitive to gas price risk and discount rates
- Other Planning Considerations
  - Cost and timing certainty; VIGP can replace HVDC sooner
  - Security of on-Island electricity and supply
  - Defer Interior-to-Lower Mainland transmission
  - Increased planning flexibility

Conclusions

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- Dependable capacity shortfall on Vancouver Island
- New resources required
- Least-cost reliable supply plan requires:
  - Long-term perspective
  - Near-term development certainty
- Few alternatives
- Significant investment and lead-time
- VIGP:
  - Preserves least-cost option
  - Furthest advanced
  - Other strategic benefits.

Panel Members

Dorell Carlson -Responsible for energy planning portfolio analysis.

Richard Marchant - Responsible for customer care and the marketing, delivery and quality assurance of Power Smart programs for BC Hydro's domestic customers.

Ron Monk - Responsible for the electricity planning group.

Jai Mumick - Is a Team Leader in transmission system planning.

John Rich - Responsible for energy issues.

Rohan Soulsby - Responsible for energy portfolio management.

Panel Members

Dorell Carlson - Responsible for energy planning portfolio analysis. Graduate of McMaster University with a Bachelor of Engineering in Engineering Physics and an M.B.A. from the University of BC. Registered member of the Association of Professional Engineers and Geoscientists of BC (P.Eng.).

Richard Marchant - Responsible for customer care and the marketing, delivery and quality assurance of Power Smart programs for BC Hydro's domestic customers. Graduated from the University of Alberta with degrees in Electrical Engineering (B.Sc.) and Master of Business Administration (MBA). Registered member of the Association of Professional Engineers and Geoscientists of BC (P.Eng.).

Ron Monk - Responsible for the electricity planning group. Graduated from University of BC with a Masters in Civil Engineering (M.Eng) and a Bachelor of Applied Science in Civil Engineering (B.A.Sc.). Registered member of the Association of Professional Engineers and Geoscientists of BC (P.Eng.).

Jai Mumick - Is a Team Leader in transmission system planning. Graduated from the University of Tasmania (Australia), and obtained a Master of Engineering degree from Concordia University.

John Rich - Responsible for energy issues. Graduated from University of BC with a Bachelor of Applied Science in Bio-resource Engineering (B.A.Sc.) and Simon Fraser University with a Master of Business Administration (MBA). Registered member of the Association of Professional Engineers and Geoscientists of BC (P.Eng.).

Rohan Soulsby - Responsible for energy portfolio management. Graduated from University of Waterloo with a Bachelor of Applied Science in Mechanical Engineering (B.A.Sc.) and Simon Fraser University with a Master of Business Administration (MBA). Registered member of the Association of Professional Engineers and Geoscientists of BC (P.Eng.).